General comments and questions from EPA Region 6 for US FWS response

November 21, 2019

Gulf Sturgeon

Numerous literature sources outlined in EPA's previous BE, as well as in those documents sent to EPA by FWS, indicate that DO concentrations ranging from 2.2 to 4.7m/L have both lethal and sub-lethal impacts (e.g. survival, DO respiration/metabolism, growth rate, activity) on Atlantic and Shortnose sturgeon, particularly juvenile and young-of-the-year life stages. Most of these studies were based on laboratory studies that maintained specimens under constant conditions of temperature, DO, and salinity in flow-through tanks, without allowance for escape from hypoxic conditions (with some exceptions, which allowed for specimens to access the air-water interface of test tanks). As noted in EPA's BE previously submitted to FWS, this does not account for both metabolic and behavioral responses by Gulf sturgeon to low DO conditions:

> "The cited studies discussed previously describe various sturgeon species' physiological response to stressors for significant periods of time in controlled environments that limit or prevent critical behavioral responses. The data indicate that sturgeon species in general have metabolic and behavioral responses to low DO conditions. Atlantic sturgeons show a partial shift to anaerobic metabolism under low DO conditions. The Gulf sturgeon is an anadromous fish, with populations in the western Gulf of Mexico inhabiting low gradient black water streams to coastal Gulf waters. The Gulf sturgeon evolved in and is adapted to stream conditions that are naturally low velocity, with mud, clay, and silt bottoms and high biomass limiting DO levels. The Gulf subspecies' genetic makeup likely provides a greater ability to shift its metabolism in anaerobic conditions. In addition to these metabolic adaptations, Gulf sturgeon exhibit behavioral responses to DO stress common to any fish species."

In our May 2019 conference call, FWS indicated that it assumes that a water quality criterion represents a "constant condition" when assessing the protectiveness of that criterion. Based on this statement, we have a couple questions:

- Does this assumption of 'constancy' apply across time (24hrs/day) and space (all parts of a water body to which the criterion applies)?
- Does this assumption foreclose the possibility of considering whether there are local, normoxic refugia to which Gulf sturgeon may migrate within waters to which the criteria apply?
- If the answer to the above is yes, does FWS have a recommended DO concentration that would satisfy the above 'constancy' requirement and be adequately protective of Gulf sturgeon?
- Do changes in fish behavior in low DO conditions that may be temporary (reduced swimming/feeding activity, increased ventilation) amount to an 'adverse effect'?